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XVII—A BOTANICAL RECONNAISSANCE IN THE VIRUNGA VOLCANOES OF KIGEZI RUANDA, KIVU.

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The present paper is an attempt to give a floristic picture of the country traversed during a plant-collecting expedition in November and December 1930 among the Virunga or Mufumbiro Volcanoes, a particularly isolated range of peaks that lies about 120 miles south of the Ruwenzori ice cap, in the great divide between the East Tropical African savannahs and the forests of the Congo Basin. The nearest mountain of any size to the east which bears a well developed alpine vegetation is Mt. Elgon (14,140 ft.), about 400 miles distant, while Kilimanjaro and Mt. Kenya both lie approximately 550 miles away.

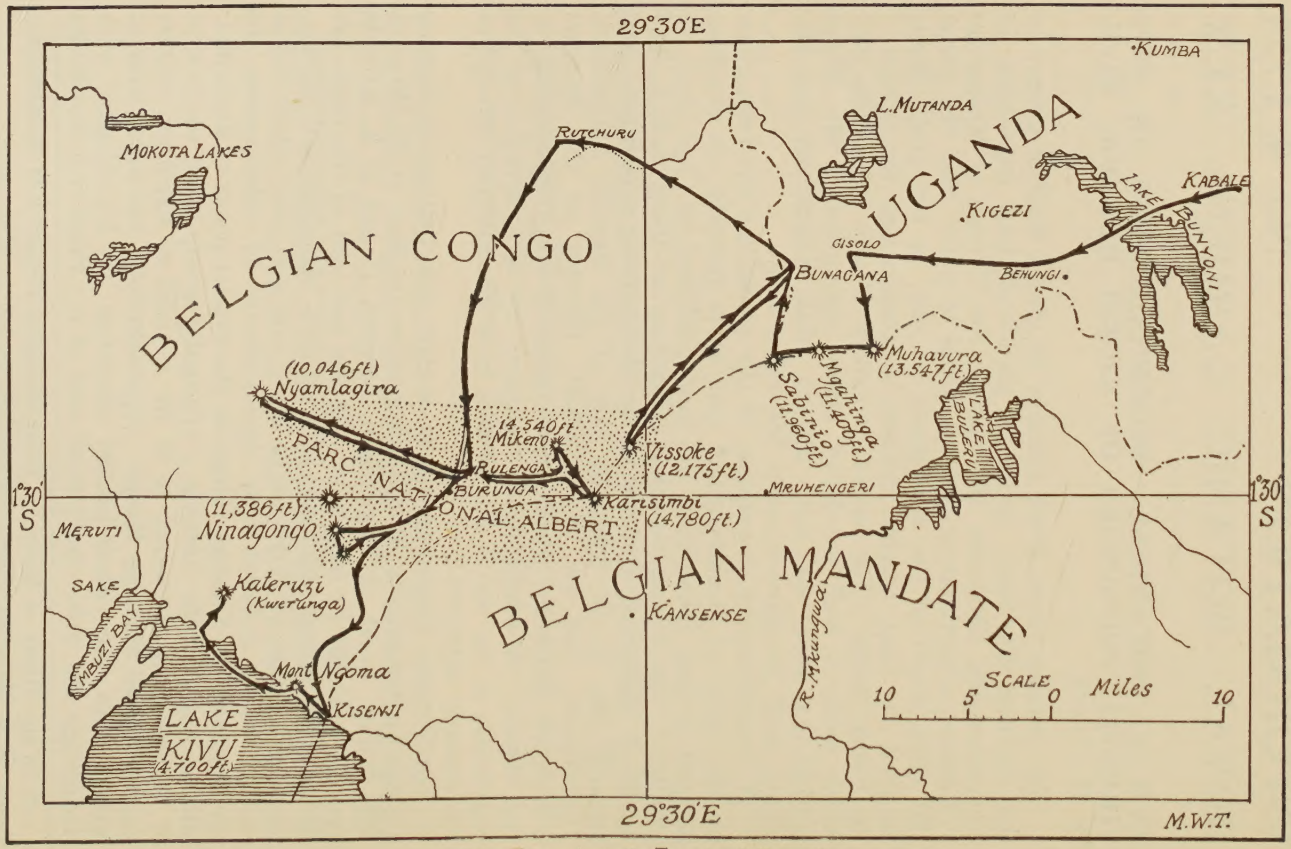
A comprehensive description of the mountains has been given by the Duke of Mecklenburg,* and, more recently, an excellent account of their inhabitants has been published by Capt. J. E. T. Phillips.† The largest botanical collections are those made in 1907 by Dr. J. Mildbraed, Botanist to the Mecklenburg expedition ; and recently Mr. J. D. Snowden, late of the Uganda Agricultural Department, and Dr. H. Humbert, Director of the Museum d'Histoire Naturelle, Paris, have collected very considerably in this region. A comprehensive account by Mr. Snowden of the vegetation of the South Kigezi area from an ecological standpoint has recently appeared.‡

The Virunga Volcanoes consist of eight principal peaks, forming a range approximately 40 miles long across the floor of the Western Rift Valley, north of Lake Kivu, between 1° and 2° S. latitude and 29° and 30° E. longitude. At the east end of the range are situated the extinct volcanoes of Muhavura, Mgahinga and Sabinio, forming a chain of three peaks lying east and west, their slopes uniting into a common base approximately 10 miles across. In the centre of the Virunga Range lie the extinct peaks of Karisimbi, Mikeno and Vissoke forming a triangular group lying south-west of Sabinio and connected to it by a chain of explosion craters known as the Mashiga Range. Approximately ten miles west of Mikeno lies the whale-backed mountain of Nyamlagira with Ninagongo ten miles south-south-east of it ; these two mountains

*"In the Heart of Africa." Duke Adolphus Frederick of Mecklenburg. Trans. G. E. Maberley-Oppler. Cassell & Co., Ltd. 1910.

†Geographical Journal, **61**, no. 4 (1923).

‡Journal of Ecology, **21**, no. 1 (1933).



Map showing the route followed.

are in a perpetually active state, resembling the cauldron craters of Kilawea and Mona Loe in the Sandwich Islands. Karisimbi, 14,780 ft. high, is the highest peak in the range and is capped with snow or hail after the violent storms which are frequent on the central mountain group. A feature of the Virunga peaks is the frequency of cloud and mist, which obscure their summits during a greater part of the year and result in the heavy growth of saturated moss in the alpine zone.

Journey to Muhavura.

We left Tanganyika Territory by lake steamer from the port of Mwanza on Lake Victoria, and, after calling, among other places, at Bukatata, where the pink-flowered *Honckenya ficifolia* Willd. and *Urena lobata* L. are abundant behind the fringing Papyrus belt, we landed at Port Bell. Thence a railway journey of 7 miles brought us to Kampala, where stores were procured for a two-months' safari. From Kampala the loads were transported 280 miles by car, via Masaka (4200 ft.) and Mbarara (4800 ft.), to Kabale (6200 ft.). Near Masaka the lake forest belt is replaced by *Themeda triandra* Forssk. grass savannahs (with *Acacia hebecladoides* Harms the dominant tree) which extend over undulating plains to the western border of the Ankole District, where the road enters the rolling, grass-covered, parallel mountain ranges, devoid of forest, that are a feature of the Kigezi-Ruanda plateau. At Kabale we commenced porter safari and followed the road which climbs over a 7000 ft. range and descends to Rutinda Camp on the eastern shore of Lake Bunyoni (6470 ft.). Crossing the lake by canoes we reached Bufundi Rest Camp on the western shore.

Mr. Snowden has, in the following words (*ined.*), described the long and steep ascent of the 8000 ft. range which flanks the western shore of Lake Bunyoni.

"From the landing place the path trails steeply upwards through a pretty wooded valley, alongside a swift-flowing mountain stream which runs into the lake. In wet soils buttercups (*Ranunculus pinnatus* Poir.), forget-me-not-like plants (*Cynoglossum lanceolatum* Forssk.), and the fern-leaved *Thalictrum rhynchocarpum* Dill et A. Rich., are very common, while, in addition to the trees and shrubs already recorded, the following were noticed: *Ericinella Mannii* Hook., *Triumfetta* sp. (no. 1622), *Barleria ventricosa* Nees., *Pentas* sp. (no. 1546), *Dodonaea viscosa* Lam., large tree-Dracaenas (*Dracaena fragrans* Ker), tree-Euphorbias (*Euphorbia antiquorum* L.), tree-Lobelias (*Lobelia gibberoa* Hemsl.), *Odina Schimperi* Hochst., *Albizzia* sp., and *Hagenia abyssinica* J. F. Gmel.

"About half way up this steep hill the woodland ceases and much cultivation and population are met with for a time. On the higher slopes and summit of the ridge, which rises to an altitude of over 8000 feet, the country gradually merges into short grass grazing lands, which are composed of most of the pasture grasses

occurring near Kabale and also *Cymbopogon afronardus* Stapf, *Hyparrhenia cymbaria* Stapf forma *macra*, *Eleusine Jaegeri* Pilger, and a variety of *Calamagrostis epigeios* Roth."

We climbed through the remnants of forest left by the natives to secondary *Vernonia* thicket, and bracken-covered slopes, dotted with *Erica arborea* L. 4–6 ft. in height. Near the summit was a clump of ragged shrubs of a species of *Smithia* (no. 2951), about 10 ft. high, with viscid foliage and pale pink flowers.

From the ridge we looked across a deep, narrow valley towards the bamboo-clad Behungi range, beyond which towered the cone of Muhavura and the jagged summits of Sabinio. We descended 800 ft. to the floor of the valley, which suggests the former presence of a lake and consists of a flat marsh, varying from a quarter to half a mile in width and extending many miles north and south and up tributary valleys.

The marsh is crossed by a 20-ft. grassy path, with a dyke on either side, and is covered with a wealth of vegetation of great beauty. The following list includes some of the more striking species:—*Ranunculus pubescens* Thunb., with yellow flowers; *Uebelenia kigesiensis* R. Good, a white-flowered herb dominant in the dyke; *Hypericum lanceolatum* Lam., fringing the swamp and forming small island-thickets near its margin; *H. peplidifolium* A. Rich., a creeping herb on the path; *Alchemilla kiwuensis* Engl.; *Crassula Wrightiana* Bullock, locally dominant where the dyke is shallow and muddy; *Lythrum rotundifolium* Hochst. ex A. Rich., with pink flowers; *Epilobium fissipetalum* Steud., frequently seen later in the marsh between Muhavura and Mgahinga; *Dipsacus pinnatifidus* Steud., at the edge of the marsh; *Helichrysum formosissimum* Sch. Bip., its white flowers covering the swamp like new-fallen snow; *H. setosum* Harv., *H. foetidum* Cass. and *Senecio* spp. fringing the swamp; *Lobelia Mildbraedii* Engl., with pale lilac flowers on stems 4–6 ft. high rising from finely pubescent leaves arranged in sessile rosettes, resembling, when young, those of *L. Deckenii* Schweinf. in the alpine marshes of Kilimanjaro; the small herbaceous species *L. minutula* Engl. and *L. stellarioides* Benth. et Hook. fil.; *Anagallis ruandensis* Knuth et Mildbr.; *Swertia calycina* N. E. Br.; *Veronica abyssinica* Fresen., these last three growing along the path; *Thunbergia alata* Boj.; *Stachys aculeolata* Hook. fil.; *Disa Stairsii* Kraenzl., with purplish inflorescences, forming thick tussocks throughout the marsh; *Kniphofia zombensis* Baker, with red and yellow flowers; *Eriocaulon mesanthemoides* Ruhl., occasional in saturated ground; small Cyperaceous herbs and the grass *Digitaria scalarum* Chiov. along the path, and the bamboo *Arundinaria alpina* K. Schum. forming impenetrable forest on the surrounding hills.

Having crossed the marsh we passed along its margin for two miles over rich humus with bamboo thicket on our left. Here occurs the striking orange fungus *Engleromyces Goetzei*, growing

from the thin branches near the apex of the canes. The fungus is from 6–12 inches in diameter, soft and white when cut, its outer surface ribbed like convolutions of the brain. Along the path occur *Plantago palmata* Hook. fil., *Trifolium usambarense* Taub. and *Viola abyssinica* Steud.

We then left the marsh and made the ascent to the ridge, over 8000 ft., through bamboo thicket, replaced at 7500 ft. by bracken slopes with *Erica arborea* shrubs 6–8 ft. high. Among the plants noted on the way were : *Parochetus communis* Hamilt., with bright-blue flowers and trifoliolate leaves, *Brillantaisia nyanzarum* Burk., 4–6 ft. high, with purple flowers, frequent on either side of the path, and *Thunbergia* sp., a climbing plant, with a white corolla and purple centre, all in the bamboo zone ; and in the *Erica* zone, *Polygala Elliotii* Chodat, with carmine flowers ; *Hibiscus diversifolius* Jacq. a shrub 4–6 ft. high, with a large, deep-purple inflorescence ; *Sebaea oreophila* Gilg, with yellow flowers and *Micromeria biflora* Benth., with pink flowers, both in the sandy soil of the bank overhanging the road, and young *Lobelia giberroa* Hemsl., in small ravines near the summit, with tall stems raising a crown of long, purple-veined leaves above the thicket of *Vernonia* sp.

The rocks are crystalline, but half-way down the steep 2000 ft. descent to the West Rift Valley the path wound round and over a turmoil of cinder cones and explosion craters, clothed with pasture grasses and dotted with native cultivation, to Nyakabande in the flat Mufumbira lava-plains. From here a motor road, metalled with lava and cinders and flanked by tall wattle trees (*Acacia decurrens* Willd.), leads through Gisolo village, about 6 miles distant, to Bunagana on the Belgian Congo frontier.

The lava blocks, worn smooth by weathering, are frequently clothed with the fern *Nephrolepis cordifolia* Pr., the orange-flowered *Gynura vitellina* Benth., and small clumps of *Lantana salviifolia* Jacq., and *Rumex maderensis* Lowe. In places the lava blocks have been piled into heaps by the natives to form small pans for the cultivation of their crops. When cultivation has been abandoned a rich pasture has developed, dominated by *Pennisetum clandestinum* Hochst., and *Digitaria scalarum* Chiov. (see Snowden, op. cit. 16, 17).

The lava plains north of Muhavura and Mgahinga, and especially those near the eastern wall of the Rift Valley north-east of Muhavura, are studded with steep-sided cinder cones. We visited one called Sajitive, two miles north of Gisolo. It is perfectly symmetrical, about 300 ft. high, its lower slopes cultivated in the native patchwork manner with crops of peas, beans, simsim, sweet potatoes and maize. The deep crater and summit are covered with short grass, in which the orchids *Satyrium sacculatum* Rolfe and *Habenaria praestans* Rendle are frequent.

Our route from Nyakabande lay southward through Gisolo and Mabunda Rest Camp to Lembwe village (about 7000 ft.) at the base of Muhavura. The following is a list of some of the plants

seen during this part of the journey : a single large tree of *Erythrina tomentosa* R. Br. at Mabunda, 40 ft. in height, and 2 ft. in diameter at 4 ft. from the ground ; *Brachycorythis Kassneriana* Kraenzl., *Satyrium sacculatum* Rolfe, both abundant for the first two miles ; *Lissochilus Wakefieldii* Rchb. f. et S. Moore ; *Eulophia stachyodes* Reichb. f. ; *Habenaria praestans* Rendle ; *Pteroglossaspis Engleriana* Kraenzl. ; *Habenaria calva* Rolfe with two opposite fleshy leaves firmly pressed to the ground and a spike of greenish-yellow flowers ; *Digitaria scalarum* Chiov., *Cynodon transvaalensis* Burtt Davy, *C. dactylon* Pers., *Pennisetum clandestinum* Hochst., all occurring on a well-made, grassy road.

Lembwe, like many other native villages at the foot of the mountain, is surrounded by a rough palisade of cuttings of *Erythrina tomentosa*, 6–10 ft. high and mostly flowering. These palisades are strengthened with the thorny shrub, *Solanum aculeastrum* Dun., and in places are festooned with an orange-flowered succulent, *Gynura ruwenzoriensis* S. Moore, and *Galium* sp. Shade is provided by groups of black-wattle trees and saplings which the natives are encouraged to plant annually in the otherwise treeless lava plains.

Ascent of Muhavura.

From Lembwe we started to climb the regular cone of Muhavura and soon passed two lava caves, festooned with *Phytolacca dodecandra* L'Hérit., a maidenhair fern (*Adiantum* sp.) and *Rumex maderensis* Lowe, the latter bearing an abundance of the yellow cocoons of a Lasiocampid moth. At 7500 ft. we reached a comparatively flat ridge, clothed with normal pasture, and 1000 ft. higher was a second shelf about 400 yards wide, covered with dense secondary thicket, 7 ft. in height, dominated by *Rumex maderensis* and with *Lantana salviifolia* Jacq., *Conyza Newii* Oliv. et Hiern, *Cluytia abyssinica* Jaub. et Spach., *Vernonia* spp., *Pentas purpurea* Oliv. and *Gynura ruwenzoriensis* S. Moore frequent. We next ascended a steep slope, on which were widely scattered bushy shrubs of *Erica arborea*, to a third shelf at about 11,000 ft. This was clothed with a tussocky grass, *Andropogon* sp., while *Helichrysum fruticosum* Vatke occurred in tufts on exposed lava. Between 11,500 and 12,000 ft. in the three parallel ravines on the north of the mountain, *Senecio Erici-Rosenii* R. E. et Th. C. E. Fries formed a densely canopied and much branched shrub 15 ft. high. Crossing a spur to the north-east, we came to a forest of the same *Senecio*, in which were many greenish-purple inflorescences of *Lobelia Wollastonii* Bak. f., forming cylindrical spikes 6–10 ft. high. The very young plants form dark-green sessile rosettes, but with age they become raised upon hollow, club-shaped axes, 4–6 ft. in height and 5–10 inches in diameter at the widest part, just below the dark-green foliage. Sunbirds (*Nectorinidae*) with irridescent, indigo plumage and long, pointed tails were commonly seen feeding at the *Lobelia* inflorescences.

From 13,000 ft. upwards the path leads through dense thickets of an arborescent *Senecio* with a much-branched canopy 6–7 ft. high and leaves covered with a slight, woolly tomentum on the lower surface. Passing out of the *Senecio* community into stony ground clothed with *Alchemilla Johnstonii* Oliv., we reached the summit. Here we found a small crater filled with greenish water, whilst large lava boulders clothed with the black lichen, *Gyrophora cylindrica* Asch., were scattered here and there. Small plants of *Senecio alticola* Mildbr. were in flower. The heavy, white-woolly tomentum covering the undersides of the leaves and the axis of the inflorescence and the distinctive pale-yellow flowers with purplish involucral bracts of this species contrast strongly with other members of the genus. Looking down the south and south-west faces of the mountain the *Senecio* was seen more frequently as a shrub 6 ft. high and the *Senecio-Lobelia* forest seemed to be more developed and at a lower altitude than we had noted on the north and north-east slopes. The following is a list of some of the more interesting plants noticed during the ascent of the mountain: *Cardamine obliqua* Hochst., growing in saturated moss on the branches of Senecios; *Arabis alpina* L. at 13,000 ft.; *Geranium angustisectum* Knuth; *Adenocarpus Mannii* Hook. fil.; *Alchemilla geranioides* Rolfe, dominant in the herb layer about 12,000 ft.; *Peucedanum Kerstenii* Engl., in a hollow at 12,000 ft.; *Dipsacus pinnatifidus* Steud.; *Helichrysum Newii* Oliv. et Hiern, on moss at the summit; *Agauria salicifolia* Hook. fil.; *Philippia Johnstonii* Engl.; *Swertia Volkensii* Gilg, at the summit; *Myrica* sp.; *Aristea alata* Baker; *Gladiolus Quartinianus* A. Rich.; *Kniphofia* sp.; and *Calamagrostis epigeios* Roth.

Mgahinga.

Our next expedition was an ascent of Mgahinga (11,400 ft.). From Lembwe we skirted the foot of Muhavura through undulating pasture and climbed through secondary thicket towards the pass (9000 ft.) between that mountain and Mgahinga by a path leading into Belgian Ruanda. The lower slopes of the mountain, between 7000 and 8000 ft., are clothed with secondary thicket similar to that at the foot of the mountain and previously described on Muhavura, but in which immature plants of *Lobelia giberroa* Hemsl., *Maesa lanceolata* Forssk., and *Rhamnus prinoides* L'Hérit are frequent. At 8,000 ft. we passed through a thin belt of sub-tropical, evergreen forest and entered dense bamboo composed of canes averaging 2 inches in diameter. Crossing a glade above a thicket of *Erica arborea* at 8500 ft., we reached the pass, which is clothed with *Hypericum lanceolatum* thicket, 6–12 ft. high, extending up Muhavura to the Senecio zone and also far up the slopes of Mgahinga. There are extensive, saturated moorland glades in the pass—dominated by *Helichrysum fruticosum* and *Anthoxanthum nivale* K. Schum.—and an exceedingly spongy marsh, over a quarter of a mile wide, occurs at the summit.

From the pass we commenced the actual ascent of Mgahinga by cutting a path through bamboo and secondary thicket, 6 ft. high, composed of *Senecio denticulatus* Engl. and *Cineraria kilimanscharica* Engl. We frequently saw the spoor and nests of gorilla, and piles of bamboo bracts where a succulent young shoot had been stripped and eaten. At 10,000 ft. we reached a rocky glade, bordered by *Hypericum lanceolatum*, which, at this altitude, becomes more bushy and is intersected with belts of *Philippia Johnstonii* Engl., a densely canopied shrub 8–10 ft. high extending to the summit of the mountain. At 10,500 ft. the *Hypericum* ceased and large shrubs of *Senecio Erici-Rosenii* occurred in deep ravines. From here to the summit the ground was boggy and much trampled by elephant, which pluck the tufted crowns of immature Lobelias.

The crater at the summit is over half a mile wide, its rather steep walls being densely clothed with *Senecio Erici-Rosenii, Lobelia Wollastonii, L. karisimbensis* and *Philippia Johnstonii.* The regeneration of the Lobelias and Senecios is evident from the profusion of young plants in the herb stratum. The crater is breached at the western end, and at the eastern end, 200 ft. higher, there is a smaller crater, 100 yds. across, containing a lake whose margins are choked with *Sphagnum.*

The following is a list of the more interesting plants, besides those already mentioned, which were noticed during the ascent: in the pastures at the foot of the mountain: *Tephrosia nigrocalyx* Bak. f.; *Gynura vitellina* Benth.; *Berkheya Spekeana* Oliv. et Hiern; *Asclepias pubiseta* N. E. Br.; *Sebaea oreophila* Gilg; *Geniosporum paludosum* Bak., which has white terminal leaves adapted for the attraction of insects to the inconspicuous pink-flowered inflorescence; *Rumex maderensis* Lowe and the orchidaceous *Habenaria Rendlei* Rolfe. At 8000 ft.: *Trifolium usambarense* Taub., *Crotalaria cleomifolia* Welw. ex Baker and *Pteridium aquilinum* L. on the margin of the subtropical forest; *Impatiens* sp. (near *I. Eminii* Warb.), *Desmodium Scalpe* DC., and *Sanicula europaea* L. in the herb stratum. In the herb layer of the bamboo forest: *Viola abyssinica* Steud.; *Trifolium usambarense* Taub.; *Plantago palmata* and *Selaginella* sp. (no. 2971). At 8500 ft.: *Helichrysum nandense* S. Moore and *Satyrium crassicaule* Rendle. On the pass at 9,000 ft.: *Ranunculus Volkensii* Engl.; *R. pubescens* Thunb.; *Cardamine obliqua* Hochst.; *Cerastium africanum* Oliv.; *Alchemilla pedata* Hochst.; *Epilobium fissipetalum* Steud.; *Lobelia utshungwensis* R. E. Fries; *Swertia Adolfi-Frederici* Mildbr.; *Bartsia similis* Hemsl.; *Eriocaulon mesanthemoides* Ruhl. In secondary thicket above the bamboo: *Vernonia ruwenzoriensis* S. Moore and *Fleurya* sp. Between 10,100 ft. and the summit: *Alchemilla geranioides* Rolfe; *Peucedanum Kerstenii* Engl.; *Helichrysum fruticosum* Vatke; *Gynura crepidioides* Benth.; *Senecio Mariettae* Muschler; *S. subsessilis* Oliv. et Hiern; *Calamintha simensis* Benth.; *Carex Lycurus* K. Schum.; *Cynorchis anacamptoides* Kraenzl.; *Pteris*

incisa Thunb. ; *Polypodium rigescens* Bory and *Asplenium praemorsum* Sw., epiphytic on saturated moss cushions hanging from branches ; *Lycopodium clavatum* L. ; *L. saururus* Lam. ; *Sticta tomentosa* Ach., a lichen on *Philippia* stems, and *Stereocaulon ramulosum* Ach., another on exposed rocks.

Sabinio.

After climbing Mgahinga we moved camp to the village of Muhindura, from where we planned to make a collecting trip on Sabinio, a precipitous mountain with five principal peaks, the highest being 11,990 ft. high. After studying the mountain from Muhavura and Mgahinga, we decided to attempt the summits from the north-west.

Leaving the village, we passed through thick secondary *Lantana* thicket into the dense evergreen forest that encircles the mountain. The path was flanked on either side with the yellow-flowered *Sida rhombifolia* L. and there were occasional glades carpeted with short grass, in which tufts of *Smithia Elliotii* Bak. f., *Trifolium usambarense* Taub., and *Spilanthes Acmella* L. were conspicuous.

Above this zone we entered thick bamboo forest, in which pathways had been opened up by elephant and buffalo, thereby making our passage considerably easier. After three hours' march we reached the foot of the cone and began the steep, fatiguing ascent through the bamboo which was now very close-growing.

At 9500 ft. the bamboo ceased abruptly and *Philippia Johnstonii*, 8–10 ft. high, became dominant. Climbing under the *Philippia* canopy was considerably easier, as there was little undergrowth, except mosses and an occasional evergreen, crimson-flowered shrub of *Vaccinium Stanleyi* Schweinf. As we ascended, the *Philippia* became shorter and at 11,000 ft. it formed a thick scrub 2–3 ft. high. About 200 ft. below the summit of the north-west peak *Senecio Erici-Rosenii* appeared, and cushions of a pale-green moss, *Brantelia Stuhlmannii* Brot., were common on saturated ground. Here and there, on gorilla trails, black hairs were observed caught in *Philippia* twigs.

From the first summit we looked into a vast and precipitously walled arena facing south, and a smaller one facing north, separated by a narrow saddle, 2–3 ft. wide, with precipices falling sharply on either side. On ledges of the first arena there were bushes of *Senecio Erici-Rosenii*, *Lobelia Wollastonii*, and *L. karasimbensis*.

After ascending successively two more peaks, we crossed a broad saddle, clothed with *Alchemilla geranioides* and reached, for the first time in history, the summit of the highest peak. Here there were scattered shrubs of *Philippia Johnstonii* and *Senecio Erici-Rosenii*, but no plants of *S. alticola* were seen.

During the ascent of Sabinio the following were among the more interesting species noticed : *Acanthus arboreus* Forst., *Agauria salicifolia* Hook. fil. and *Maesa lanceolata* Forssk. on the lower

slopes. In the evergreen forest: *Trichilia Volkensii* Gürke, *Xymalos monospora* Baill., its branches clothed with epiphytic species of *Polypodium*, and *Croton macrostachys* Hochst., with *Pavonia kilimandscharica* Gürke, *Vernonia podocoma* Sch. Bip. and *Piper capense* L. in the shrub layer, and *Thalictrum rhynchocarpum* Dill. ex A. Rich., *Desmodium Scalpe* DC. and *Coleus* sp. (No. 2983) bordering the path. In the thickly forested ridges extending up the side of the cone *Hypericum lanceolatum* Lam., *Loranthus kagehensis* Engl. parasitic on *Vernonia podocoma*, *Athyrium umbrosum* Pr., and *Selaginella* sp. (no. 2971); *Mikania scandens* Willd. in glades dominated by *Discopodium penninervium* Hochst. and *Girardinia bulbosa* Wedd. with violently stinging hairs; *Carduus leptacanthus* Fres. and *Helichrysum Newii* Oliv. et Hiern on lava pebbles of the second peak.

Vissoke.

Leaving Sabinio, we crossed lava pasture with small thickets of *Rumex* and other genera, and grassy, shallow-soiled plains with *Helichrysum fruticosum* dominant, to Bunagana on the Belgian Congo border, where there is a Government Rest Camp. Bunagana hill is an extraordinary cinder ridge, 200–300 ft. high and over 1 mile long. In the evening a splendid view is obtained of the eastern and central Virunga peaks with Nyamlagira to the west and the escarpment wall behind it. On the way to Bunagana *Osbeckia abyssinica* Gilg, a pink-flowered herb in moist hollows, *Borreria Princeae* K. Schum. and *Aeolanthus repens* Oliv. on lava outcrops, and *Habenaria Keiliana* Kraenzl., growing in cyperaceous marsh, were conspicuous. On Bunagana hill our path passed through coarse grassland where *Themeda triandra*; a large *Digitaria*-like species; *Linum gallicum* var. *abyssinicum* Planch.; *Eriosema montanum* Bak., a yellow-flowered bush 2–4 ft. high, and *Orobanche minor* Sutton, common in pasture and old cultivation, were noted.

Mt. Vissoke (12,580 ft.) appears from the north as a regular truncated cone and is a most difficult mountain to approach, being guarded on all sides by subtropical evergreen and bamboo forests. We followed the line of the proposed new road from Rutchuru to Ruanda, crossing Mashiga, a high range of cinder hills and craters between Sabinio and Vissoke, and ascended the latter from the south-east. After a march of two hours through cultivated land, we came to a belt of evergreen thicket much frequented by elephant. Passing an isolated savannah-clad cone, we crossed a short-grass swamp, and re-entered the forest of bamboos, where *Croton macrostachys* Hochst. ex A. Rich. and *Neoboutonia macrocalyx* Pax were fairly frequent. As the ascent grows steeper, however, the bamboo becomes very large and quite dominant. Its stems, 4–8 inches in diameter at the base, rising in clumps 18–20 ft. apart and arching overhead, form a canopy 60 ft. or more high. The ground is covered with straw-coloured bamboo culm sheaths 3–5 ft. long and 1½ ft.

wide. In open glades *Viola abyssinica, Trifolium usambarense* and an *Impatiens* sp. form a carpet over which fly many of the small fritillary butterflies (*Brenthis excelsior*). At 9000 ft. we descended by an exceedingly muddy tract to an open marsh studded with shrubs of *Erica arborea*; then for six hours we hacked our way through dripping-wet bamboo forest till we came to the foot of the cone of Vissoke. Among the plants found were *Habenaria Keiliana* Kraenzl.; *Cyanotis hirsuta*; *Xyris capensis* Thunb., a delicate yellow-flowered herb; *Kniphofia Snowdenii* C. H. Wright; *Senecio pammicrocephalus* S. Moore, and *Lathyrus kilimandscharicus* Taub., common on grass tussocks; *Luzula Volkensii* Buch., occasional among shorter grasses; *Parochetus communis* and *Carduus kikuyorum* abundant in glades; and in the mud at the side of the tracks *Crassula Wrightiana* Bullock.

At the foot of the cone the bamboo ends abruptly and is replaced by *Hagenia abyssinica* forest consisting of trees with trunks 4–6 ft. in diameter, which were the largest of this species seen in Virunga. The undergrowth is at first composed chiefly of shrubs of *Discopodium penninervum* Hochst. and a species of *Vernonia* allied to *V. ruwenzoriensis*; later the ground becomes carpeted with *Anthriscus dissectus* C. H. Wright, a white-flowered umbelliferous plant 4–6 ft. high, the so-called "celery" eaten by gorilla. At the foot of the cone a gorge was discovered whose fern-covered walls are moistened by a waterfall, and here the delicate ochre-flowered *Corydalis Mildbraedii* Fedde, the white crucifer, *Cardamine africana* Hochst., *Crassula Wrightiana* Bullock and *Urtica massaica* Mildbr. were collected.

As we ascended, trees of *Hypericum lanceolatum* 40–60 ft. high became frequent, until at 9500 ft. they had almost entirely replaced the *Hagenia*. *Lobelia giberroa* Hemsl. becomes common in thickets of *Senecio denticulatus, Impatiens* sp. and *Fleurya* cf. *F. podocoma* (no. 2847). At 10,000 ft. are the bracken-like *Hypolepis* sp. (no. 3017) and scattered shrubs of *Senecio Erici-Rosenii*; 500 ft. higher the latter is dominant, with *Alchemilla geranioides* forming a tangled, silvery herb layer, while *Hypericum* has dwindled to a small shrub; *Lobelia karisimbensis* and *L. Wollastonii* are common up to the summit. In the large eastern crater arborescent Senecios are conspicuous and on the north wall a patch of *Senecio alticola* stood out in sharp contrast to the commoner species. The top of the mountain is covered by an extensive morass dominated by *Carex runssoroensis* K. Schum, whose spiny, glaucous tussocks grow out of the Sphagnum bog in which *Lycopodium saururus* Lam. is common. Owing to heavy cloud drift it was not possible to explore the mountain top and the reputed crater lake was not seen.

We now returned to Bunagana, marching along the motor road to Rutchuru, the Belgian administrative headquarters. For the first four miles the country consists of typical lava plains with cultivation already described, while near Rutchuru River banana

plantations become frequent. The river, which is flanked by tall Papyrus, enters a dense forest of *Albizzia gummifera* C. A. Smith and elephant grass, *Pennisetum purpureum* ; the road follows the river and descends steeply for some miles to the floor of the rift valley.

The lower country in the neighbourhood of Rutchuru is dominated by elephant grass and impenetrable thickets of *Acanthus arboreus*, while *Erythrina tomentosa* occurs frequently on hillsides. Marching south towards Mt. Mikeno, camp was made at Kitale, where small forests of *Albizzia gummifera* and *Spathodea nilotica*, *Acanthus arboreus* in dense thickets on the volcanic slopes, and *Phoenix reclinata* along the banks of streams were noted. Nearing the " White Father's " mission of Rulenga (Lulenga) the road traverses the recent block lava of 1905 that will be discussed later in this paper. At Rulenga the safari was organised for a week's trip to Mikeno and Karisimbi, and Monsieur Jean de la Vallée Poussin, of the Mission Géologique du Congo Nord, Kivu, consented to be my companion in an attempt to ascend the unconquered summit of Mikeno.

Mikeno.

Leaving Rulenga we marched through cultivation on steep red-soil slopes with areas of *Pennisetum clandestinum* pasture and *Erythrina tomentosa* hedges, and, entering *Acanthus arboreus* and *Vernonia* thicket, we reached the village of Kibumba after two hours, having passed on the way a large explosion crater the cinder slopes of which were clothed with *Agauria salicifolia-Dombeya* sp. savannah and areas of high forest trees, while an orchid with grass-like foliage and pink flowers, *Polystachya vulcanica* Kraenzl., was also frequent.

We ascended through *Acanthus arboreus* thicket 12 ft. high, in which *Croton macrostachys*, *Erythrina tomentosa* and *Senecio multicorymbosus* were common, to a small circular crater filled with grassy swamp. Passing this, the path, clothed with *Sanicula europaea* and *Plantago palmata*, climbs steeply to bamboo forest at 6500 ft. On the left is a deep gorge which we followed until, after a steep ascent through a mixed bamboo-*Hagenia* belt, we emerged above a high waterfall, with a cliff rising perpendicularly some 200–300 ft. from the valley below. Here *Erica arborea* and *Lobelia giberroa* are scattered along the banks, and other plants noticed were : *Euphorbia Schimperiana* Hochst., *Helichrysum Goetzeanum* O. Hoffm., *Sibthorpia australis* Hutch., and *Dryopteris africanum* C. Chr.

Leaving the gorge we climbed steeply through bamboo-*Hagenia* forest where *Xymalos monosperma* was frequent. The boughs of the trees were covered with moss and other epiphytes including *Lycopodium Phlegmaria* L. At 8200 ft. the path passes from bamboo to pure *Hagenia* forest with *Anthriscus dissectus* dominant in the undergrowth. As we neared the saddle between Mikeno

and Karisimbi, trees of *Hypericum lanceolatum* and *Senecio Erici-Rosenii* became frequent, also the epiphytic ferns *Polypodium lineare* var. *elongatum* Takeda, *Asplenium praemorsum* Sw. and *Elaphoglossum hirtum* C. Chr. At the saddle we came to the clearing, 300 yards long and 50 yards wide, called *Kabara* by the natives. At one end is Carl Akely's grave, which, like the whole clearing, is carpeted with flowers, while at the eastern end is a small, circular swamp from which water for the camp was procured. Small trees and shrubs of *Hypericum lanceolatum* and a pink-flowered bramble (*Rubus* sp. no. 3036) grow on outcrops of lava where the rocks themselves are clothed with *Sedum epidendrum* Hochst. and *Viola abyssinica* Steud. Other plants collected were *Ranunculus pubescens* Thunb., *R. oreophytus* Del. and the white-flowered *R. stagnalis* Hochst. ex A. Rich.; *Corydalis Mildbraedii* Fedde; *Cardamine hirsuta* Hochst. and *C. obliqua* Hochst.; *Subularia monticola* A. Br.; *Arabis alpina* L.; *Montia lamprosperma* Cham.; *Trifolium* sp. (no. 3053); *Vicia angustifolia* L., on grassy banks; *Alchemilla pedata* Hochst.; *Anthriscus dissectus* C. H. Wright; *Peucedanum Kerstenii* Engl.; *Helichrysum helothamnus* Moeser; *Veronica glandulosa* Hochst., in grass tussocks; *Calamintha simensis* Benth.; *Rumex afromontanus* R. E. Fries; *Carex Petitiana* A. Rich., up to 3 ft. high; *Poa annua* L. var. dominating small areas, and the tussock-forming *P. leptoclada* Hochst.

From Kabara we cut our way up a steep slope, and by using buffalo-trails reached 10,500 ft. fairly easily. On the way we noticed that the *Anthriscus dissectus* had been pulled up over considerable areas by gorilla; the plant is stripped of its leaves exposing the white heart of the lower part of the stem, which is eaten. At this altitude the *Hagenia* becomes smaller and is interspersed with groves of *Philippia Johnstonii* 15 ft. high; at 11,000 ft. the former ceases altogether and the bush is co-dominated by the *Philippia* and *Senecio Erici-Rosenii* 8–10 ft. in height. Small glades are frequent and contain *Rubus runssorensis* Engl. var. (no. 3064), with edible, purple fruits; *Conyza gigantea* O. Hoffm. and *C. montigena* S. Moore; *Helichrysum formosissimum* Sch. Bip. and *Deschampsia ruwensorensis* Chiov. growing in patches of moss.

We then crossed a narrow saddle which plunges steeply for several hundred feet on the western slope; *Poa leptoclada*, *P. perplexa* and *Helichrysum Newii* were found here in stony soil. At 12,000 ft. *Philippia* was left behind and we entered almost pure stands of *Senecio alticola* composed of plants in all stages of development, some attaining much branched shrubs 10 ft. high; great range in the size of leaf and in the woolliness of the under-surface was noticed. On a moist slope a patch of *Carex runssoroensis* was seen, but *Alchemilla geranioides* was the dominant herbaceous plant. At 12,500 ft., however, the latter is replaced by cushions of moss, while splendid plants of *Lobelia karisimbensis* and *L. Wollastonii* become frequent, with many seedlings. As we climbed

the final peak of Mikeno with the aid of ropes, we found *Senecio alticola* confined to ledges and crevices, and becoming more scattered as we ascended. At approximately 14,000 ft. it was a shrub 6 ft. high with considerably less tomentum on the under-surface of the leaf, the midrib tending to be reddish and the margin distinctly curled inwards. We found the records left by Madame Léonard and Père Van Hoef who, in 1927, reached a point higher than any before them: we were, however, only able to ascend a few metres more before we too were beaten by the moss-covered precipice, while above us was the unconquered summit with *Senecio* shrubs scattered along its skyline.

Karisimbi.

Descending again to Kabara we prepared to climb Karisimbi, the highest peak in the Virunga Range (14,780 ft.). After an hour of *Hagenia* and *Hypericum* forest we reached the open marshy plateau called Rukumi, a mile wide and fringed with 30-ft. trees of *Philippia Johnstonii*. *Hypericum lanceolatum* Lam. and *Senecio Erici-Rosenii* R. E. & Th. C. E. Fries among shrubs, and the herbs *Ranunculus oreophytus* Del., *Cardamine obliqua* Hochst., *Subularia monticola* A. Br., *Alchemilla geranioides* Rolfe, *Luzula Volkensii* Buch., *Scirpus setaceus* L., *Carex Lycurus* K. Schum., *C. Petitiana* A. Rich. and *Agrostis* sp. (no. 3090) were the only plants in flower. From Rukumi the sharply-defined zones of *Philippia*, *Senecio* and *Alchemilla* clothing the northern slopes of the cone of Karisimbi were plainly visible. The zones commence at a distinctly lower altitude on the eastern than on the western slope, where *Lobelia karisimbensis* and *L. Wollastonii* were seen in profusion. This suggests that the south-east wind prevails and is more severe than winds from the north-west. We followed buffalo spoor through *Alchemilla* to 13,000 ft. where the scattered and stunted shrubs of *Senecio alticola* cease, and the steep slope is entirely carpeted with *Alcehmilla*, on which drifts of new-fallen snow were encountered. At 13,500 ft. scree of bare volcanic soil and ash with outcrops of lava appear, which at about 14,200 ft. become united into a barren slope which forms the summit of the peak. The black lichen *Gyrophora cylindrica* Ach. is common on exposed lava blocks.

Mushubangabo and Nyamlagira.

Having returned to Rulenga, we prepared for an expedition to the active volcano of Nyamlagira (10,046 ft.), via the extinct cone Mushubangabo. The path traverses two distinct forms of recent lava flow: one composed of sharp, angular blocks, treacherous to walk over, which have flowed from the Kaanama-hararge volcano of 1905 and other older vents; the other is relatively smooth, black-coloured lava, suggestive of billowy pavement. For the first part of the march to Mushubangabo crater, the lavas are crossed alternately, but later the block lava ceases altogether.

The vegetation on the two kinds of lava is very different: the block-lava supports scattered shrubs and epiphytic herbage, while the smooth lava is covered with pioneer forest with a rich herbaceous canopy. On the block-lava *Hymenodictyon floribundum* Robinson, *Cussonia Holstii* Harms and *Myrica* sp. (cf. *M. arborea* Hutch.) are pioneer shrubs and near Rulenga *Rumex maderensis* Lowe, *Pycnostachys* sp., *Pentas longiflora* Oliv., and *Lantana salviifolia* Jacq. are frequent. The angular blocks, which vary from a few inches to several feet across, are clothed with moss and a grey lichen, *Stereocaulon denudatum* Fl., and support an epiphytic vegetation which includes *Polypodium phymatodes* L.; *Dryopteris orientalis* C. Chrj.; *Aerangis brachyceras* Summerhayes, a pale-yellow, sweet-scented species; the yellow-flowered, succulent *Polystachya cultriformis* Lindl., *P. vulcanica* Kraenzl., and a less common species with white, waxy flowers, *Aerangis* sp. (no. 3122).

The commoner plants on the smooth lava are: *Triumfetta rhomboidea* Jacq., in bare places; *Toddalia asiatica* Lam.; *Rhamnus prinoides* L'Hérit.; *Dodonaea viscosa* Jacq.; *Rhus villosa* var. *tomentosa* Schonl.; *Cussonia Holstii* Harms; *Galium* sp. (no. 3106), a common climber; *Borreria Princeae* K. Schum.; *Vernonia jugalis* Oliv. et Hiern, *Coreopsis Elliotii* S. Moore, *C. steppia* Steetz and *Senecio denticulatus* Engl. forming a yellow and lilac-flowered stratum of herbs 3–4 ft. high in open glades; *Dichrocephala chrysanthemifolia* DC.; *Mikania scandens* Willd.; *Jasminum abyssinicum* R. Br.; *Myrica* sp., and the fern *Nephrolepis cordifolia* Pr.

In moist hollows and depressions in the lava flow grow a lilac-flowered herb, *Erlangea longipes* S. Moore, the blue-flowered *Sonchus Schweinfurthii* and a tall grass *Hyparrhenia cymbaria* Stapf. Where the forest canopy is partially closed *Desmodium Scalpe* occurs in profusion, also *Eragrostis Dekindtii* Pilger, *Melinis Goetzenii* Mez, and *Sporobolus capensis* Kunth, the latter growing only in cracks in the lava along a narrow native pathway.

Mushubangabo is a regular cinder cone about 100 ft. high enclosing a circular crater pond of muddy water about one hundred yards across, which is much frequented by elephant. The crater is clothed with dense forest of *Croton macrostachys*, *Albizzia sassa*, *Mimusops* sp. and *Bersama* sp.; a single young tree of *Podocarpus milanjianus* was seen while *Pavetta ruwenzoriensis* was common in the underbrush: ferns noted included the terrestrial *Pteris dentata* Forssk. and the epiphytic *Loxogramme lanceolata* Pr.

Between the crater of Mushubangabo and Nyamlagira, a tall white-flowered tree (*Syzygium* sp. no. 3128) was commonly seen growing with *Hypericum lanceolatum* and spiny *Gymnosporia* bushes. By following elephant paths we arrived at the foot of Nyamlagira and entered a belt of very moist evergreen forest which extends along the east and north-east flanks of the mountain and is, except for a belt near Burunga on the south-west slopes of Mikeno, the largest seen among the volcanoes. The chief trees of this forest

are *Podocarpus milanjianus* and *Xymalos*; *Dracaena reflexa* was frequent. Orchids were represented by *Aerangis rhodosticta* Schltr., a very spectacular plant with tresses of large white flowers which show up strongly in the forest gloom; *Rhipidoglossum xanthopollinium* Schltr.; *Bulbophyllum gravidum* Lindl. and *Diaphananthe Burttii* Summerhayes. Ferns noticed included *Hymenophyllum ciliatum* Sw. on fallen logs, and the epiphytes *Elaphoglossum Aubertii* Moore, *E. hirtum* C. Chr., *Vittaria lineata* Sw. and *Polypodium* spp. As we worked round and began to ascend the northern slopes of the volcano we entered a forest of *Hypericum lanceolatum* with scattered trees of *Cornus Volkensii* 20–30 ft. high and large specimens of *Agauria salicifolia* up to 40 ft. in height. Ascending by a watercourse, with the blue-flowered *Aristea alata* and the pink *Satyrium crassicaule* Rendle growing in the grass alongside, *Erica arborea* and carpets of *Helichrysum Hochstetteri* were frequent, until at 8500 ft. we came to long gentle slopes dominated by *Philippia Johnstonii* and *Myrica kilimandscharica* Engl.; here *Anthospermum usambarense* K. Schum., *Senecio maranguensis* O. Hoffm., *Helichrysum nandense* S. Moore and the pale-yellow *Conyza ruwenzoriensis* R. E. Fries were also common. At 9000 ft. the slopes are composed of black, billowy lava, the humus in the numerous cracks and crevices supporting *Cineraria abyssinica* and mature but stunted plants—4–6 ft. high—of *Lobelia giberroa*, the leaves of which a herd of elephant was seen plucking and devouring. Large areas of *Philippia* have been killed by a recent eruption of the volcano and the dead stems give a desolate appearance to the landscape.

At 10,000 ft. we reached the rim of the great crater which is 1½ miles across. Here we found *Lycopodium clavatum* growing in warm, steaming fissures, and on the cinder slopes scattered shrubs of *Rumex maderensis*, *Lobelia giberroa* and *Anthospermum usambarense*, but no *Senecio Erici-Rosenii*. Entering the crater from the north-west, the floor of the first terrace is seen to be composed of cinder-covered lava, clothed with a wealth of *Cineraria abyssinica*, *Helichrysum fruticosum*, tufts of grass and a few *Rumex* shrubs 6 ft. high. Towards the east and west the vegetation has been killed or is non-existent owing to the presence of sulphur dioxide fumes from the molten lava. Crossing the upper terrace for half a mile we looked into the steaming, inner terrace 400 ft. or more below, and were surprised to see a flourishing colony of *Lobelia giberroa* about half-way down a precipitous cinder-slope. The plant life in the crater appears to indicate that the prevailing winds at this season are south-east or north-west.

Ninagongo.

Having returned to Rulenga our next march was southwards to Burunga. The motor-road traverses block lava for the first part, but later winds through a number of large explosion craters

PLATE VII

Looking towards Vissoke from Lake Mutanda with Mt. Mikeno (right) and Mt. Sabinio (left). (Photo. by P. Mowbray)

The peak of Mt. Muhavura appearing above the East Wall of the Rift Valley at Behunge. (Photo. by P. Mowbray.)

[*To face page* 160.

whose cinder slopes are clothed with splendid forest in which the following large trees were noted: *Albizzia gummifera* C. A. Smith, *Antiaris usambarensis* Engl., *Croton macrostachys*, *Croton* sp., *Schefflera* sp. and a large species of *Conopharyngia*. In the undergrowth shrubs of *Piper* and *Vernonia*, a trailing pink-flowered *Begonia* and a tree fern 10 ft. high were seen.

From Burunga the road passes for some miles over block-lava, followed by smooth lava flows from Ninagongo, whose smoking cone rises on the right to 11,380 ft., and which we approached through Kibati village. The vegetation resembles that encountered below Muhavura and Mgahinga except that the scattered thickets are larger and small trees of *Erythrina tomentosa* more frequent.

In pastures the following were noted: The white-flowered rambler *Clematis inciso-dentata* A. Rich.; *Crotalaria mesopontica* Taub.; *Vernonia cistifolia* O. Hoffm. with lilac-blue flowers; *Helichrysum* (*Achyrocline*) *Hochstetteri* Hook. fil.; *Lactuca capensis* Thunb.; the pink-flowered *Sopubia ramosa* Hochst.; *Orobanche minor* Sutton; *Micromeria biflora* Benth.; *H. Rendlei* Rolfe; *H. praestans* Rendle; *H. Thomsoni* Rchb. f.; *Eulophia ochracea* Schltr., an erect plant with compact terminal inflorescence of small sienna-red flowers; *Gladiolus Quartinianus* A. Rich., and the fern, *Nephrolepis cordifolia* Pr.

Entering the margin of the forest belt at the foot of Ninagongo, at about 5500 ft., we passed through thickets of *Vernonia podocoma* into dense forest of *Croton macrostachys* and *Neoboutonia macrocalyx*, with undergrowth of *Piper capensis* and *Desmodium Scalpe*. Ascending a steep slope, *Xymalos* and large specimens of *Podocarpus milanjianus* become frequent. At 7500 ft. the trees are covered with wet moss, *Plagiochila* sp. supporting the epiphytes *Loxogramme lanceolata* Pr., *Asplenium Sandersonii* Hook., *Trichomanes pyxidiferum* L., and a small succulent-leaved *Lobelia* (no. 3216). At 8000 ft. the forest changes abruptly to thicket of *Hypericum*, *Agauria*, *Erica arborea*, *Myrica*, *Maesa lanceolata* and young trees of *Hagenia*. Between 8500 ft. and 9500 ft. *Philippia Johnstonii* is almost entirely dominant growing as a shrub 10 ft. high; further up the mountain, however, it becomes smaller, until at 10,000 ft. it is only 3–5 ft. high, and is interspersed with *Anthospermum usambarense*, *Senecio Erici-Rosenii*, and *Lobelia giberroa*. At this altitude, also, much *Philippia* has recently been killed by sulphur-dioxide fumes from the crater. Ridges of almost bare lava pebbles become frequent supporting a thin scrub of *Helichrysum Newii*. On the eastern slope of the cone 6 ft.–high shrubs of *Senecio Erici-Rosenii* and *Lobelia giberroa*, with *Senecio subsessilis* and an umbellifer, *Malabaila abyssinica*, are common and extend up to 11,000 ft.; but on the west and north-west slopes all vegetation down to 9000 ft. has been killed.

Above the *Senecio* belt a grass (*Agrostis* sp. no. 3176) is dominant in crevices on the steep and otherwise bare lava slopes. Dead

stems of *Senecio* and *Lobelia*, which are seen frequently in crevices up to the crater rim, show that, until comparatively recent times, vegetation flourished there and that the volcano is increasing in activity. The great crater, which is over a mile across, is devoid of vegetation, as it is frequently completely filled with clouds of sulphur-dioxide fumes from the lava caldrons a thousand feet below the crater floor.

Common or noteworthy plants collected on the way up include *Polygala Elliotii* Chodat ; *Peucedanum runssoricum* Engl. ; *Helichrysum nandense* S. Moore ; *Gynura crepidioides* Benth. ; *Senecio maranguensis* O. Hoffm. ; *Cynoglossum amphifolium* Hochst. ex A. Rich. ; *Lithospermum officinale* L. ; *Rumex maderensis* Lowe ; *Pilea ceratomera* var. *Mildbraedii* Engl., common up to 8000 ft. ; *Polystachya kermesina* Kraenzl., an epiphytic orchid previously seen on Mt. Mikeno ; the pink-flowered *Satyrium crassicaule* Rendle ; saplings and young trees of *Podocarpus milanjianus* Rendle, below 9000 ft. ; the tree fern, *Athyrium umbrosum* Pr., with a trunk 1 ft. high, common up to 8000 ft. ; *Lycopodium clavatum* L.

Leaving the active central cone of Ninagongo, we passed over a narrow saddle clothed with *Podocarpus* and *Xymalos* forest to the large extinct southern crater. The inner wall of this is very steep and clothed on the southern and western slopes by impenetrable bamboo thicket, and on the east and north by evergreen forest. The forest at the foot of the northern crater wall, at about 9000 ft., is dominated by *Hagenia*, with *Hypericum*, 20–30 ft. high, fringing a short-grassed, circular moorland area, about half a mile across, which covers most of the crater floor. Among the *Hypericum* and *Hagenia* is a narrow belt of *Senecio Erici-Rosenii* consisting of shrubs over 15 ft. high, and this is the lowest altitude at which this plant was seen. Large thistles and the fern *Athyrium umbrosum* Pr. dominate in the herb stratum ; other interesting plants were *Lobelia Mildbraedii* Engl. which has pale-green- and lilac-flowered inflorescences 3–6 ft. high, and of which many young plants were seen ; *Crepis carbonaria* Sch. Bip. and *Helichrysum fruticosum* Vatke in short-grass areas ; *Helichrysum formosissimum* Sch. Bip. and *Carduus kikuyorum* R. E. Fries in great profusion on the moor towards the centre of which was a colony of *Calamagrostis epigeios* Roth.

Kisenji and Lake Kivu.

Having returned to Kibati, our next journey was to the town of Kisenji on Lake Kivu at 4768 ft. The country between Kisenji and Ngoma village consists of smooth lava flows with pasture, scattered cultivation and thickets of *Acanthus arboreus*. The lake shore is fringed with a narrow belt of small-tree thicket in which were noted : *Toddalia asiatica* Lam. ; *Bersama* sp. (no. 3256) ; *Pterolobium exosum* Bak. fil. ; *Cussonia Holstii* Harms ; *Euphorbia* sp. (near *E. ingens* E. Mey.) ; *Ficus* sp. Climbers at the edge of the thickets were *Capparis erythrocarpa* Isert ; *Vernonia Tufnellae* S.

Moore ; *Senecio subscandens* Hochst. ; *Jasminum dichotomum* Vahl. ; *Lissochilus Oliverianus* Rchb. fil. and *Habenaria genuflexa* Rendle were seen locally in small clearings along the lake shore, and *Barleria ventricosa* Hochst. ex Nees, with beautiful pale blue flowers and an orange *Kalanchoë* (cf. *K. Petitiana* A. Rich. no. 3227) on rocky outcrops. Common in waste land and pasture were : *Crotalaria striata* DC ; *Pentas longiflora* Oliv. ; *Wedelia Menotriche* Oliv. et Hiern ; *Bidens pilosa* L. ; *Hyptis spicigera* Lam. ; *Pteris aquilina* L. The shrubs *Capparis roseiflora* Gilg. et Benedict, *Carissa edulis* Vahl, and *Erythrococca rigidifolia* Pax were scattered in savannah lands.

A flow of comparatively recent block-lava lies between Ngoma and Mont Ngoma, a grassy-sloped cinder cone with complex craters on the shore of Lake Kivu ; this is clothed with impenetrable thicket of which the chief constituents are *Rhus natalensis*, the dominant shrub ; *Olea chrysophylla*, a tree 20 ft. high ; *Carissa edulis* ; *Clerodendron myricoides* ; *Jasminum dichotomum* ; *Rumex maderensis* and *Senecio multicorymbosa*, which is common near the lake. The ferns *Nephrolepis cordifolia* and *Polypodium phymatodes* are frequent where the lava is more exposed. The chief plants in the craters of Mont Ngoma, which are breached on the side facing Lake Kivu, are : *Justicia flava*, which, with the less-common *J. Betonica*, forms a coarse herbaceous carpet on the floor of the eastern crater ; *Phytolacca dodecandra* L'Herit forming tangled thickets on the lower slopes ; and on the upper grassy slopes *Dodonaea viscosa* Jacq., *Rhus natalensis* Bernh. ; *Carissa edulis* Vahl ; and the herbs *Pseudarthria Hookeri* Wight et Arn. ; *Asclepias pubiseta* N. E. Br. ; *Geniosporum paludosum* Benth. ; *Micromeria biflora* Benth. *Sesbania aegyptiaca* Ait. and *Pluchea Dioscoridis* DC. grow locally on the marshy floor of the middle crater whose walls are covered with impenetrable thorn thicket of *Gymnosporia* sp., *Carissa edulis* and *Toddalia asiatica*, supporting little undergrowth except *Sanseviera* and the crimson *Haemanthus Mildbraedii* Perkins which is very abundant in all thickets along the lake shore.

The many small cinder cones and explosion craters that lie along the north shore of Lake Kivu between Kisenji and Sake are clothed with similar vegetation to that on Mont Ngoma, but shrubs of *Entada abyssinica* Steud. and *Acacia verugera* Schweinf. are common on the cones half way along the coast. Between Mont Ngoma and Kesheru the plains are chiefly composed of block-lava clothed with dense thicket, but near Kesheru lava of the smooth type occurs and is clothed with pasture and island thickets, in which large trees of *Cussonia Holstii*, *Erythrina tomentosa* and *Albizzia gummifera* were seen ; large areas are covered with thicket of woody herbs among which *Crotalaria axillaris* Dryand with large yellow flowers, *Lantana salviifolia* Jacq., *Hoslundia opposita* Vahl and *Pseudarthria Hookeri* Wight et Arn. are the most important. The lake shore itself is fringed with shrubs of *Sesbania aegyptiaca*, while *Potamogeton pectinatum* L. grows in profusion in water 1½–2 ft. deep.

Near Kesheru there are frequent cracks in the lava which emit copious quantities of slightly warm carbonic acid gas, which flows down furrows in the grassy pasture to the lake. The herbage, in which *Cyperaceae* are frequent, is stunted and slightly yellowish-brown where inundated by CO_2. A dead crow, a cuckoo and a number of small yellow butterflies were seen in one furrow where they had had the misfortune to shelter.

Kwerunga.

From Kesheru we travelled for about five miles by canoe, owing to the impenetrable thicket which clothes the country around ; we landed at Katerusi (Kwerunga), the scene of the violent eruption of 1912–1913. For half a mile we passed through rich banana plantations, native gardens, pasture and thickets of *Acanthus arboreus*. Common trees were *Erythrina tomentosa, Cussonia Holstii* and *Entada abyssinica*. The herbs *Crotalaria Claessensii* De Wild. and *Oldenlandia abyssinica* Hiern were noted in pasture grazed by the long-horned Ankole cattle. After another mile and a half of thicket the path emerges into the country which was devastated by the flow of lava from Kwerunga crater, and which extends along a wide front to Lake Kivu and the Sake gulf. The lava blocks are clothed with a lichen (*Stereocaulon denudatum* Flk.) which gives them a sinister, grey appearance, broken only by the scattered, pioneer plants of *Senecio Hochstetteri* Sch. Bip. Crossing the lava field we came to a small island of country at the foot of the cone which had not been touched by the lava flow ; here was a flourishing thicket of *Rhus glaucescens* A. Rich. and *Ficus ingens* Miq. which had evidently regenerated from the old rootstocks buried deeply in volcanic debris and cinders.

The tumult of hills, 200–300 ft. high, which surround the cone of Kwerunga are composed of volcanic blocks, fine black cinders and beds of red ash highly impregnated with salt (sodium chloride) which is industriously mined by the natives. The hills cover an area of about five square miles and are surrounded by impenetrable thicket on all sides, except for the devastated region facing Lake Kivu. *Senecio Hochstetteri, Pteris vittata*, forming tufts with fronds 1–2 ft. high, and *Rumex maderensis* are scattered generally over the lower hills, while in more sheltered places grow *Oldenlandia corymbosa* L., *Mariscus Sieberianus* var. *evolutior* C. B. Cl. and the grass *Rhynchelytrum roseum* Stapf et C. E. Hubbard. The cone of Kwerunga supports little vegetation and in places it is so hot that rocks in fissures near the summit boil water with explosive violence. In spite of this several shrubs of *Ficus ingens* 3–5 ft. high were found growing within 30 ft. of the hot fissures, having germinated from seeds dropped in the dung of monkeys which frequently visit the crater. *Helichrysum leptothamnus* Moeser grew nearby, and colonies of the ferns *Nephrolepis cordifolia, Polypodium phymatodes* and *Pteris vittata* were seen within the explosion crater quite near hot fissures from which carbonic acid gas escaped. No other species of plants were

seen on the Kwerunga hills, which thus present an ideal area for the study of colonisation and plant succession.

Summary.

1. A collection of 453 numbers of plants was made from the eight volcanic peaks of Virunga, and the lowland country around them. A further 39 numbers were collected on the way to Virunga.

2. The alpine flora of the eight peaks is of one type, dominated by *Senecio Erici-Rosenii*, with a relatively poor number of other alpine plants.

3. The alpine flora is subject to much cloud, giving great humidity and excluding bright sunlight throughout the year—with resulting low day temperature and the prevention of frequent ground-frosts that are a feature at similar elevations on Kilimanjaro.

4. The sub-alpine and sub-tropical evergreen forests greatly resemble in composition the forests seen on East African mountains, and many species occur in both regions.

Conclusion.—I wish to thank the Director of the Royal Botanic Gardens, Kew, for obtaining the necessary permission from the Belgian Government for me to form a collection of plants in the Parc National Albert, as well as for providing funds covering my travelling expenses from Tanganyika Territory to the Kivu country and back. I would also thank the Herbarium staff at Kew for their interest in supplying the names of the plants collected in Virunga, which has greatly facilitated the compilation of this paper.

XVIII—NEW OR LITTLE-KNOWN PLANTS FROM SOUTH INDIA: III.*

Sonerila tinnevelliensis *C. E. C. Fischer*, sp. nov. [Melastomaceae]; *S. Brunonis* W. et A. affinis, sed minor, ramulis teretibus, foliis lanceolatis basim inaequalibus nervis basalis unijugis, calyce glanduloso-piloso, capsulis minoribus, seminis ellipsoideis differt.

An erect *undershrub* 12–30 cm. high; roots spreading, fibrous, hairy; stem woody below, more or less branched, nodes slightly swollen; twigs terete, glabrous, the youngest red. *Leaves* thinly membranous, lanceolate, usually narrowly so, acuminate, base cuneate, very unequal sided, one side always acute, the other acute or rounded and descending 2–7 mm. below the other, blade 4–11 cm. long, 1·2–2·7 cm. wide, with a few scattered smaller pairs intermixed, midrib slightly elevated below, lowest pair of nerves arising from above the shorter side, arching and running for $\frac{1}{3}$–$\frac{1}{2}$ the length of the blade, the next pair above running to about $\frac{1}{3}$ from the apex, followed by 4–5 slender short pairs, 1 or 2 nerves arising from the longer side below the insertion of the shorter side, ultimate reticulations small and fine, glabrous or with a few crisped hairs on the nerves, margins distantly serrate, serratures pointing forward, usually tipped

*Continued from *K.B.* 1933, 357.

with a short bristle ; petioles slender, 1·5–4 cm. long, glabrous, red. *Racemes* axillary and terminal, secund, few- to 30-flowered : rhachis red, 8–15 mm. long in flower, hardened and lengthened in fruit up to 4·2 cm. long, leaving small tubercles after the fall of the fruit, erect and straight or slightly curved throughout ; pedicels 4–5 mm. long, red when young, articulated on small tubercles, indurating and falling with the fruit, glabrous or with a few gland-tipped hairs, especially near the apex ; bracteoles on the tubercles minute,

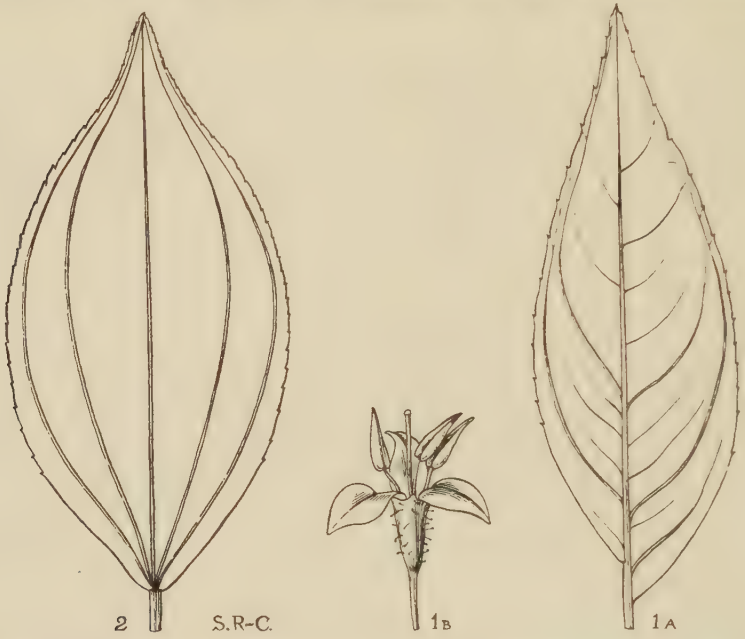


Fig. 1A, B. *Sonerila tinnevelliensis* C. E. C. Fischer. 1A, leaf nat. size. 1B, flower × 2.
Fig. 2. Leaf of *Sonerila Brunonis* W. et A., nat. size.

bearing a few gland-tipped hairs. *Calyx* narrowly funnel-shaped, 4–6 mm. long, shallowly 6-ribbed, bearing scattered, crisped, gland-tipped hairs, teeth, short, broadly triangular, acute. *Petals* 3, ovate-lanceolate, acute, 5–6 mm. long, pinkish-mauve (when dry), veined, glabrous on the upper surface, with a row of gland-tipped hairs on the mid nerve below. *Stamens* 3, glabrous ; *filaments* slender, erect, 2·8–4 mm. long ; *anthers* linear-lanceolate, bluntly acuminate, base narrowly cordate, 4·3–5 mm. long, golden-yellow. *Style* linear, slender, 8–9·5 mm. long, glabrous ; *stigma* small, capitate, minutely papillose. *Capsule* funnel-shaped, thinly corky, 5·5–6 mm. long, bluntly 6-ribbed, the ribs carried down the persistent petiole, apex very shortly 3- or 6-toothed, pale-brown, shining. *Seeds* escaping before the fall of the capsule, ellipsoid, 0·6–0·8 mm. long, muricate, at least near the apex, usually with a short apical bladder-like appendage.

Travancore: *Beddome*, without precise locality or number. Tinnevelly District: Kanikatti, frt. June, *C. A. Barber* 385; Agastiarmalai, frt. May, *C. A. Barber* 2900; River Payar, frt. May, *C. A. Barber* 2971; Kalivayalpil to Kanikatti, fls. and frt. June, *C. A. Barber* 3103; near Knapp's Hut, 2000–4000 ft. fls. and frt. Jan., *E. Barnes* S4a (type); (all above in Kew Herb.); Papanasam Hills, near Wood's Hut, fls. and frt. Jan., *E. Barnes* without number.

This species has been confused with *S. Brunonis* W. et A., Barber's 4 specimens being identified as that species. Beddome's specimen, which is fragmentary, is inscribed "Probably new, but too imperfect." The leaves and glandular-hairy calyx separate the two readily. It was not till the receipt of Prof. Barnes' specimens (collected in January 1933) that attention was directed to these older ones.

Arisaema convolutum *C. E. C. Fischer*, sp. nov. [Araceae-Aroideae]; *A. Leschenaultii* Bl. affine, foliis majoribus, cauda spathae multo longiore, appendicibus spadicis cephaloto-convolutis differt.

A dioecious glabrous succulent *herb*. *Tuber* subdiscoid, 6 cm. wide, 2·5 cm. deep, light-green, much puckered on the surface, bearing several small pear-shaped bulbils, rootlets from the uppermost part of the new tubers numerous, succulent, pinkish, sometimes stoloniferous. *Cataphylls* 2–3, up to 20 cm. long, thin, obtuse. *Leaf* solitary; *petiole* terete, sheathing the peduncle for 2–3 cm., up to 63 cm. long and 2·5 cm. diam. at the base, light-green with numerous fine longitudinal purple striations; *segments* radiate, sessile, 7–15 (commonly 11–12 in the ♀ plants and 9–11 in the ♂), narrowly oblanceolate, finely caudately acuminate, in the larger leaflets the tail is filamentous and up to 5 cm. long, base tapered and decurrent, 12–38 cm. long (excluding the filamentous tail), 2·2–8·8 cm. wide, midrib stout, very prominent below, primary nerves subparallel, up to 20 or so in large leaflets, arising from the midrib 0·6–2 cm. apart at an angle of 30°, slightly raised below, uniting in a looped intramarginal vein 1–5 mm. from the erose, purple margin, secondary nerves fine, usually 3 between each pair of primaries, anastomosing, dark-green and somewhat glossy above, light-green and very glossy below, clammy to the touch. *Peduncle* terete, like the petiole but more slender, up to 40 cm. long. *Tube of spathe* narrowly funnel-shaped, 4–6 cm. long, 1·7–2 cm. wide at the mouth, split to the base, its edges overlapping to right or left, mouth sometimes slightly revolute, white with a yellowish-green tint near the margins, limb expanded, overarching, ovate, acuminate, margins involute towards the apex, 3·5–10 cm. long, 3–6 cm. wide, terminated by a pendant, ultimately filiform appendage 4–17 cm. long, purple, often very dark, within with 5–7 white bands tapering to a point towards the apex, paler without, veins corresponding with the white bands raised to form ridges on the outside. *Spadix* straight, sessile, a little longer than the tube of the spathe; of ♂ 4·8–6·2 cm. long,

Fig. 3. *Arisaema convolutum* C. E. C. Fischer. A, plant; B, ♂ spadix; C, ♀ spadix. All × ⅔.

floriferous portion 1·6–2·4 cm. long, cylindric or narrowly conical; stamens scattered, mauve; *filaments* rather stout, 0·5 mm. long; *anthers* subglobose, opening by a pore; *neuters* 0; *appendix* cream-coloured, cylindric, sometimes slightly widened shortly above the flowers and then subclavate, terminated by a sublogose or clavate convoluted knob 0·8–1·3 cm. long. ♀ *spadix* 7 cm. long; floriferous portion 2–2·5 cm. long; ovaries crowded (up to 185 in number), subglobose, 2·5 mm. diam., bright-green with a crystalline appearance; *style* very short, stout, dark-purple; *stigma* muricate, mauve; *ovules* 4, *seeds* (in semi-ripe fruit) usually 2, sometimes 1, 3 or 4; *neuters* 0 or 3–5 among and above the uppermost flowers, subulate, green, up to 1 cm. long; *appendix* similar to that of the ♂ but more swollen in the middle and the convolute apex usually a little larger.

Nilgiri Hills: Pennant Shola, Parson's Valley, 7000–7500 ft., fls. May-June, *E. Barnes* AR7, "Found plentifully in several *sholas* on the S. side of Parson's Valley: rare in Governor's Shola. Where it was abundant appeared to be very wet by exposure to the S.W. monsoon. Grows on horizontal branches, in forks and on the roots of trees; also in the ground in leaf-mould."

Professor Barnes supplies the following observations: "The inflorescence has a strong putrid smell . . . definitely stronger on the tail of the spathe than in the tube or on the spadix. The inflorescence matures before the leaf opens, and in . . . male plants is often over and decomposing by the time the leaf has fully expanded. The ♂ plants are about ⅔ the dimensions of the ♀. . . . Underground runners are also apparently formed as a corm was found from which there emerged a brown stem that thickened into a smaller corm 2 in. away. There is no doubt that ♂ plants are more numerous than ♀."

Carex rara *Boot* subs. **capillacea** *Boot* [Cyperaceae].

The typical species is recorded from Ceylon as well as from the Eastern Himalayas and the Malay Archipelago; the subspecies (treated in the Flora of Brit. Ind. as a separate species), however, has not been found hitherto in the Indian region south of Sikkim and Bhutan and it was not, therefore, included in Part 9 of the Fl. of the Pres. of Madras (1931). Recently Prof. Barnes sent specimens to Kew, so that this sub species must be added.

Nilgiri Hills at Ootacamund, c. 7000 ft., *E. Barnes* without number.

Coelachne Meeboldii *C. E. C. Fischer*, sp. nov. [Graminae-Poaceae]; a *C. pulchella* R. Br. spiculis paucioribus et majoribus, rhachidibus pedicellis rhachillisque planis recedit.

Annual *herb* with short, very slender, fibrous roots. *Stems* very slender, glabrous, flaccid, trailing and rooting at the nodes, up to 45 cm. long, emitting a few suberect, sometimes branched, flowering culms up to 10 cm. long. *Leaves* distant on the trailing stems, approximate and at first overlapping on the flowering culms; *sheaths* loose, slightly widened upwards, shallowly ribbed and very

minutely scaberulous without, 1–1·8 cm. long, mouth truncate or with very short, rounded auricles on either side ; *ligule* a fringe of short hairs ; *blade* narrowly ensiform, subacute, 5–10 mm. long, flat or more usually involute, about 10-nerved, very minutely scaberulous. *Raceme* solitary, terminal, 2–3 cm. long, embraced at first by the uppermost sheath, later emerging : rhachis flat, channelled, 1–1·2 mm. wide, glabrous, joints usually 3, 3–5·6 mm. long, the uppermost shortest, more or less curved to accommodate the spikelets. *Spikelets* usually 3 pairs, 1 sessile and 1 pedicelled at the lower internodes, the apical pair sessile at the base and apex respectively of the uppermost joint ; *pedicels* flat, channelled, 2·8–3·4 mm. long, 0·5–0·6 mm. wide, glabrous. *Glumes* membranous, subequilong, 2·7–3·5 mm. long, glabrous, the lower flat or slightly concave, ensiform, subacute or obtuse, 3-nerved, the upper broader, oblong or elliptic-oblong, obtuse, concave, 5-nerved. *Florets* dissimilar, the lower the larger, its lemma membranous narrowly oblong, rounded at the apex, concave, 4–4·3 mm. long, margins narrowly inflexed, 7–9-nerved, glabrous ; its palea slightly shorter, elliptic-oblong, subacute, with widely inflexed margins nearly meeting, glabrous, nerveless. *Lodicules* minute. *Stamens* 3 ; anthers linear, 2·7 mm. long. *Rhachilla* between the lemmas 0·7–1 mm. long, flat, widening upwards with a transverse ledge above the middle, glabrous. *Upper lemma* coriaceous, broadly oblong, hemispheric in cross section, 2–2·3 mm. long, margins narrowly inflexed, back minutely punctate, sparsely hairy, the sides all round shaggily hairy ; palea slightly shorter, coriaceous, elliptic-oblong, subacute, margins inflexed, back flat, minutely punctate, hairy, enclosing a ♀ floret. *Lodicules* 2, short, oblong-quadrate or ligulate, truncate, glabrous. *Ovary* linear-ellipsoid, glabrous. *Grain* oblong, obtuse, plano-convex, 1·5–1·6 mm. long, fuscus, with a median longitudinal reddish-brown (red at first) line on the plane face.

Cochin State at Chalakudi, Nov., *A. Meebold* 12520 (type in Kew Herb., cotype in Breslau Herb.), " In tanks."

The plants appear to grow interlaced in dense mats.

Tripogon pungens *C. E. C. Fischer*, sp. nov. [Gramineae-Poaceae] ; ab omnibus congeneribus caule crasso ramoso vaginis vestito, foliis equitantibus rigidis pungentibus differt.

A densely tufted perennial *herb*. *Stems* branching, up to 20 cm. high, thickened with the imbricating old leaf-sheaths, slender, wiry and usually long-exserted above ; nodes concealed by the sheaths. *Leaves* mostly near the base, equitant, coriaceous ; sheaths 5–10 mm. long, imbricate, striate ; ligule represented by a minutely-hairy ridge ; blades convolute or involute, rigid, pungent, often curved, 1–5 cm. long, glabrous below, 6–8-ribbed and minutely hispidulous above. *Spikes* numerous, terminal, solitary, 4–6 cm. long ; rhachis narrow. *Spikelets* 7–9-flowered, narrowly ellipsoid, 4–6 mm. long. *Glumes* membranous ; the lower 2–2·5 mm. long, with a large lobe on one side, each lobe with a single nerve, obtuse (sometimes the glume

Fig. 4. *Tripogon pungens* C. E. C. Fischer, nat. size.

completely divided into 2 subequal parts) ; upper 3–4 mm. long, oblong, acute, strongly 1-ribbed, back rounded or more or less keeled. *Rhachilla* disarticulating at the base of each floret ; joints 0·6–1 mm. long, terete, more or less hairy. *Lemmas* with a short callus bearded with white hairs $\frac{1}{4}$–$\frac{1}{3}$ as long as the lemma, chartaceous, broadly ovate, obtuse, apex shortly 2-lobed, the lobes obtuse, bearing an arista from the sinus, 3-nerved, the lowest 2·5 mm. long with an arista 0·8–1 mm. long, the upper gradually smaller ; paleas oblanceolate, obtuse, complicate, 2–2·2 mm. long, 2-keeled, keels ciliolate, containing a bisexual floret. *Lodicules* 2, minute, narrowly obcuneate, truncate. *Stamens* 3 ; anthers oblong, 1 mm. long. *Ovary* minute, subglobose ; styles 2, distant at the base. *Grain* not seen.

S. Coimbatore District at Punachi in the Anaimalais Hills, about 3500 ft., Oct., *C. A. Barber* 3717 (type in Kew Herb., cotype in Madras Herb.). Several plants 4–6 cm. high, devoid of inflorescence, collected by *Sir A. G. and Lady Bourne* (no. 3011) at Neutral Saddle in the Palni Hills in June, is also this plant beyond doubt.

From its habit one would suppose that the plant grew among rocks with the lower part of the stem in crevices.

XIX—MISCELLANEOUS NOTES.

Robert Chodat.—We record with deep regret the death of Professor Robert Chodat, Professor of Botany in the University of Geneva, on April 28th, 1934. Professor Chodat was a botanist of remarkable versatility and enriched many diverse branches of botanical science by his researches. In his earlier years he worked on the *Polygalaceae* but his main botanical activities lay in the direction of morphology, physiology and biology. The *Algae* of the fresh-water lakes were subjects of his special study and his " Monographes d'Algues en culture pure " is among the best-known of his many publications.

Professor Chodat will always be remembered by his establishment of the Alpine Laboratory, " La Linnea," at Bourg St. Pierre, where every summer he conducted classes, and a band of students and research workers gathered around him to study the many problems presented by the alpine vegetation in its natural surroundings.

Professor Chodat was awarded the Linnean Medal in 1933, and was an Hon. Sc.D. of Cambridge, Liverpool and Manchester. He spoke English perfectly and he was a most charming and interesting companion, since his knowledge, both scientific and literary, was encylopaedic. It may safely be said that there was no branch of botany with which he was not fully conversant and to which, at some time, he had not made important contributions.

Brooklands, New Plymouth.—The Dominion of New Zealand is fortunate alike in the unique character of its native vegetation and in the generosity of its citizens. A few years ago we noted in the " Kew Bulletin " (1929, 63) the opening of the Otari Open Air Museum

at Wellington. Now we have to record with much interest the presentation of the Brooklands estate to the Borough of New Plymouth as a public reserve by the Trustees of the late Mr. Newton King. The official opening of the property as a public reserve by His Excellency the Governor General, Lord Bledisloe, took place on March 10th, 1934.

Brooklands adjoins Pukekara Park, a very beautiful public park belonging to New Plymouth, and forms a natural extension of it; together they cover an area of over one hundred acres. In addition to the actual domain of Brooklands, the Trustees have presented five acres of native bush adjoining and, in order to give proper access to it and to make the whole one large reserve, Mr. T. C. List and Mr. C. A. Wilkinson have given an area of seven and a half acres.

Mr. Truby King, representing the members of the family of the late Mr. Newton King, formally handed over the property to the Borough Council on behalf of the Trustees of the estate and the members of the family. The estate forms part of the grant of land made to Captain King—who was unconnected with the family—in 1841; on his death in 1888 a portion was purchased by Mr. Newton King and comprises the estate now handed over to New Plymouth.

His Excellency the Governor General, after referring to the many public services performed by the late Sir Truby King, Mr. Newton King and other members of the family and to their great munificence in making this presentation, drew attention to the outstanding natural advantages which New Zealand possesses. "In two respects," Lord Bledisloe pointed out, "New Zealand is absolutely unique in the world. One is the number, variety and grandeur of its beauty spots within a relatively small area and other is its native bush which has no rival in the world. And there is economic value as well as aesthetic delight inherent in Nature's generous equipment.

"I make bold to utter a prophecy to the truth of which only your grandchildren can confidently testify," said His Excellency. "It is that New Zealand's main source of wealth will not be found in sheep-breeding, goldmining, petroleum wells or even dairy farming, but in its tourist traffic; for hundreds of thousands will flock here from all over the world to see that sun-kissed land in the Pacific which Nature has most abundantly endowed with her aesthetic jewels. For every £50 that may accrue from the short-sighted felling in face of temporary economic stringency of some forest giant such as the great Kauris of the Waipoua forest, at least a million pounds is lost to posterity in the permanent commercial value of the natural beautification of the Dominion, quite apart from the spiritual inspiration which its contemplation evokes in every normal civilized being. And why should not New Plymouth be the centre of enlightenment for this purpose to the whole Dominion, radiating sanity and foresight as well as a love of the beautiful, bringing to men's hearts and minds the pure happiness

and mental peace which flow from contact with unspoilt nature and an intimate knowledge of her incomparable treasures? New Plymouth is well fitted for this much-needed pioneer task. Her children are trained in the schools to know and to love native plants and to cultivate thereby that capacity for observation which is a priceless equipment for every vocation in life. She has a sufficient rainfall, which while promoting growth is also some safeguard against destruction by fire, an equable climate, a rich, deep porous soil and a volcanic subsoil. In the matter of variety of types of indigenous timber trees and plants she is ideally situated in a geographical sense. Here North meets South and sub-tropical and temperate plants alike flourish in profusion—plants characteristic of the flora of both islands. It is significant that here in this generously equipped reserve is to be found, close to the extreme southern limit of its natural habitat, the largest and symmetrically the most perfect Puriri [*Vitex littoralis*] in the Dominion, and what tree can claim in its durable and fine-grained timber, its foliage, its flowers and its fruit, greater all-round beauty or utility? You have, too, tree ferns and Todeas of a size and quality which even Westland would find it difficult to emulate.

" I see around me," said Lord Bledisloe, " not merely native bush and well-trimmed English lawns, but also fine specimens of exotic trees imported from Great Britain and elsewhere 90 years ago, the most striking being the great Spanish chestnut with a lateral spread of 90 feet—a truly wonderful tree, and I can say so with confidence, because I have on my family estate the oldest and finest grove of Spanish chestnuts in England, containing one tree of 24 feet girth at breast height, but none with such far-spreading lateral branches as yours. In this connexion I may venture to utter a word of warning, although conscious that it is unnecessary to do it, so far as your present enlightened borough authorities are concerned. It is this. Do not on any account, and however great the temptation may be, mix up your native and your exotic trees, even if a love of the Old Land, or a pride in the ' Devon, glorious Devon ' of your ancestors should stir up sentiment in favour of incursions of the latter into the sacred precincts of the former. If you or your children effect this promiscuous intercourse, this magnificent environment of pure native bush will be for ever ruined in the eyes not only of expert botanists but of those who love symmetry and arboreal compatability and who deem Nature's primeval plan to be better even than that of the most experienced landscape gardener."

Landscape Gardening.*—This book, which deals with all phases of garden construction and layout, should prove invaluable for anyone planning a garden, whether large or small. The subject

* By Richard Sudell, F.I.L.A., A.R.H.S. Messrs. Ward Locke & Co., Ltd., London & Melbourne. Price 21*s*.

is dealt with in such simple language that beginners should have no difficulty in following the various operations described, and, at the same time, there is much that the professional can study with profit. There are many excellent illustrations showing various types of gardens with details regarding their layout.

In addition to chapters dealing with constructional details for the ordinary garden, there are others on Town and Roof Gardening, Factory and Hotel Gardens, Airport Development, and Landscape Architecture in Relation to Estate Development. There are eight chapters dealing with gardens of other nations, each one contributed by a native of the country in question. These are valuable as a contrast to the opening chapter which deals with the history of the English garden. Not the least useful feature is the very complete list of plants suitable for all classes of garden soil and situations.

J. COUTTS.

Peonies.*—As the use of the American spelling of the title indicates, this book is written primarily for the American amateur and based on American climatic conditions. For the most part, however, the information given in this book applies equally to both sides of the Atlantic, especially the chapters dealing with vegetative propagation, hybridizing, and seed sowing

Much sound advice is given on soil, drainage, planting and manuring, on the control of insect and fungus pests, and on the selection of stock. There are extensive lists of varieties, grouping them by colour, height and fragrance, and also giving a selection of the 50 best varieties, adopting the valuation, or rating as it is termed, of the American Peony Society. These lists are, however, of very little value to British gardeners, as few of the varieties are in cultivation here. It is interesting to note that a British variety, Kelway's Glorious, is placed second on the list with a rating of 9·8, and the old favourite, festiva maxima, at 9·3, whilst the newer Lady Alexander Duff stands at 9·1.

In a book of 70 pages the author devotes rather more than one page to " Some Interesting Species and Varieties," mentioning only 6 of the 30 or so known species, and omitting some of the most beautiful, or earliest flowering kinds, such as *P. cretica* and *P. anomala*, whilst throughout the book the lovely single varieties are not given the credit they deserve.

One of the principal objections to the freer use of peonies in border work is the large blanks left in the colour scheme from the end of July onwards and not everyone will agree with the author's statement that " the general effect of a Peony when it is not in bloom is that of a low-growing dense and beautifully foliaged shrub."

In his Classification of Flower Forms he adopts five types—single, Japanese, Anemone, semi-double and double—and these are

*By F. F. Rockwell. With an introduction by C. C. Sherlock. Drawings by George Holbrock and the author. New York. The Macmillan Company. 1933. Price 4*s.* 6*d.*

well illustrated. He is to be congratulated on scrapping the ambiguous, and to us unfamiliar, type names such as bomb, semi-rose and crown.

The book is well arranged and printed and should prove useful to those interested in the genus both as garden plants and as subjects for commercial growing. G. W. ROBINSON.

The Toxicology of Plants in South Africa.*—The publication of this work marks the second important contribution to the study of South African poisonous plants that has appeared during the last few years (K.B. 1933, 463). In the present volume the whole subject of plant poisoning of domesticated animals in South Africa, and, to a less extent of human beings, is considered, fundamental as well as specific aspects of plant poisoning being critically dealt with.

The earlier pages of the volume are devoted to a general discussion of plant poisoning and include interesting chapters on the factors determining toxicity in plants and on the action of plant poisons. Information that should appeal especially to stock-owners is that relating to diagnosis, treatment and prevention of poisoning, eradication of harmful plants, and legal aspects of plant-poisoning. Special sections are devoted to " poisonous foodstuffs," " photosensitization," and " fungi in relation to health of man and animal."

The latter and greater part of the volume consists of a systematic account of the known species of poisonous plants occurring in South Africa. Under each species notes are given regarding distribution, toxicity, active principles, post-mortem appearances, etc. The book is freely illustrated with photographs which are taken in some instances from the growing plant and in others from herbarium specimens. A useful bibliography and index are included.

F. N. HOWES.

Erratum.—In K.B. 1934, 97, line 7, " Engler's Jahrb. **66** " should read " Engler's Jahrb. **65**."

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